SYSTEMIC CRISIS MANAGEMENT AND CENTRAL BANK INDEPENDENCE. AN EMPIRICAL ANALYSIS

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Abstract
The current financial crisis, through its global dimension, resulted in an intensification of efforts of specialists to find the best policies for crisis management, on the one hand, and to improve the regulatory and supervision framework, on the other hand, both essential conditions for restoring the confidence in the financial system.
The goal of the present study is to build a bridge among these recent studies and other approaches, older or newer, on the role of central bank in ensuring financial stability.
More concrete, the goal of our scientific approach is to determine, based on empirical analysis, if there is a relationship of dependency between the costs of systemic crises and central bank independence, an issue, otherwise, little explored in literature.
In other words, we will try to answer the question: *Do central banks with higher degree of independence manage systemic crises more effectively than with lower level of independence?* At first glance, the answer would be that central banks with higher degree of independence are able to manage more efficiently systemic crises. The results of the empirical analysis based on a sample of 40 systemic crises, however, led us to another conclusion, namely those central banks with higher degree of independence showed a poor performance in reducing the costs and duration of the crisis, but managed to maintain lower inflation rates during these periods.

Keywords: systemic crisis; duration / depth of the crisis; central bank independence index; regression model

JEL Classification: G01

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Introduction

In the literature, there are many approaches to the concept of systemic crisis. Most of them consider that a crisis is systemic when problems arising at a bank or more are serious enough to have a significant impact on the entire economy - whether it is the payment system disruption, massive drop in credit flow, asset values collapse, the deterioration of macroeconomic indicators or economic growth interruption (Bogza, 2007, p. 68).

For the purpose of this study, however, we operate with the definition given by Laeven and Valencia (2008a, p. 5), which was used by other authors too (Cecchetti, Kohler and Upper, 2009, p. 9; Detragiache and Giang Ho, 2010). According to them, a systemic crisis is an event where:

"*a country's corporate and financial sectors experience a large number of defaults and financial institutions and corporations face great difficulties repaying contracts on time. As a result, non-performing loans increase sharply and all or most of the aggregate banking system capital is exhausted. This situation may be accompanied by depressed asset prices ... sharp increases in real interest rates, and a slowdown or reversal in capital flows. In some cases, the crisis is triggered by depositor runs on banks, though in most cases it is a general realization that systemically important financial institutions are in distress*".

Given the costs induced by a systemic crisis, some authors have been concerned with the study of their pathology, closely related to the factors associated with them, and the economic, fiscal, and social costs involved.

Other authors turned their attention to crisis management strategies, trying to identify the most effective of them. Although analysis regarding the efficiency of different crisis management policies in shortening the duration of the crisis and reducing adverse effects are few, they may nevertheless constitute a starting point for more sophisticated studies.

Thus, Laeven and Valencia (2008a) developed a comprehensive database on policies used to stabilize the banking sector during systemic crisis between 1970 and 2007. The authors found, based on partial correlations analysis, that certain crisis management policies are more effective than other policies in restoring the viability of the financial system. The same authors (2008a, p. 6-20) prove, through empirical analysis, that policies such as liquidity support, government guarantees for certain financial institutions and forbearance from prudential regulations are very costly and do not accelerate economic recovery process. Instead, the introduction of a blanket guarantee on all deposits can restore, in their view, the confidence of depositors in the banking sector, but not the confidence of external creditors (2008b). Also, the authors show that bank closures and the establishment of asset management agencies are positively correlated with increasing non-performing loans and high fiscal costs, confirming the results obtained by Klingelbiel (2000, p. 30).

Regarding the institutional framework necessary for an effective systemic crises management, Laeven and Valencia (2008a, p.4-14) show that institutional weaknesses related to accounting and transparency standards, bankruptcy proceedings, creditors' rights and the judiciary system deepen the crisis and complicate the recovery of the economy. In this regard, policy makers in countries with weak institutions should take into account that they cannot expect similar results to those obtained by developed countries in restructuring

and that there is a need to design recovery mechanisms and an appropriate institutional framework.

At the same time, in a study on the involvement of central banks in crises in Latin America, Luiz Jacome (2008) shows that an effective crisis management must be based on four main pillars: taking early corrective action; the existence of effective tools for restructuring and recovery of banks; the deposit insurance system; central bank's quality of lender of last resort.

Since central banks have a role, explicitly or inherently[1], in maintaining financial stability and in managing systemic crisis, we believe it is useful to study institutional factors that may influence decisions and the use of certain instruments in this process. In this study, we focus on central bank independence.

On this issue, the first problem to be addressed is how to measure central bank independence. A first measure is the degree to which regulations in a given state grant the central bank freedom in setting its goals, this measure being often referred to as *legal* or *political independence*. It consists of examining the influence of government in appointing the central bank's Governor and Board, the duration of their mandate, the final objectives, and other legal characteristics of the central bank[2].

Another aspect to be considered in measuring central bank independence, analyzed by Grill, Masciardano and Tabellini, is *economic independence*, which represents the central bank freedom to choose its monetary policy and the instruments considered appropriate.Thus, economic independence refers to the instruments controlled by the central bank as the monetary interest rate, banking supervision, the possibility of the government to borrow from the central bank and the interest on which these loans are granted.

The issue of central bank independence has also been studied by Debelle and Fischer (1994), the authors considering useful the distinction between *goal independence* - which is the central bank freedom to set its final goals - and *instrumental independence* - that is the freedom to choose the appropriate tools for achieving the objectives.

Traditional indexes of central bank independence are built based on the political and economic independence. Thus, the GMT index is built based on 15 criteria, each marked with 0 or 1, the index final value being given by the sum of marks for each criterion, and its high values indicating a high degree of central bank independence. Instead, Cukierman index is based on the evaluation of 16 criteria of political and economic independence, each marked by a continuous interval between 0 and 1, the final value of the index being a weighted average for each criterion, and its high values indicating a high degree of central bank independence.

Table no. 1 presents the values of Cukierman, Webb and Neyapti (1992) index, calculated by Polillo and Guillén (2005), for countries that experienced periods of systemic crises and that were included in the empirical analysis performed in this study.

[1] although not explicitly mentioned, it often results from the double role of the central bank as monetary policy and prudential authority.
[2] note that many instruments for measuring legal independence were built for industrialized countries.

Table no. 1: Central bank independence index for countries that experienced systemic crises

No.	Country	Crisis date	CBI	No.	Country	Crisis date	CBI
1	Argentina	Mar-80	0.4	21	Jamaica	Dec-96	n/a
2	Argentina	Dec-89	0.4	22	Japan	Nov-97	0.47
3	Argentina	Jan-95	0.74	23	Korea	Aug-97	0.44
4	Argentina	Dec-01	0.74	24	Latvia	Apr-95	0.49
5	Bolivia	Nov-94	0.3	25	Lithuania	Dec-95	0.25
6	Brazil	Feb-90	0.21	26	Malaysia	Jul-97	0.36
7	Brazil	Dec-94	0.21	27	Mexico	Dec-94	0.56
8	Bulgaria	Jan-96	0.55	28	Nicaragua	Aug.00	0.63
9	Chile	Nov-81	0.77	29	Norway	Oct.91	0.17
10	Colombia	Jul-82	0.27	30	Paraguay	May-95	n/a
11	Colombia	Jun-98	0.44	31	Philippines	Jul-97	0.48
12	Cote d'Ivoire	1988	n/a	32	Russia	Aug-98	0.49
13	Croatia	Mar-98	0.44	33	Sri Lanka	1989	n/a
14	Czech Republic	1996	0.73	34	Sweden	Sept-91	0.29
15	Dominican Republic	Apr-03	n/a	35	Thailand	Jul-97	n/a
16	Ecuador	aug.98	n/a	36	Turkey	Nov-00	0.46
17	Estonia	Nov-92	0.78	37	Ukraine	1998	0.42
18	Finland	Sep-91	0.28	38	Uruguay	Jan-02	0.54
19	Ghana	1982	0.31	39	Venezuela	Jan-94	0.63
20	Indonesia	Nov-97	0.27	40	Vietnam	Oct-1997	n/a

Source: Polillo and Guillén (2005)

We can observe a high level of central bank independence in countries like Czech Republic, Estonia, Chile and Argentina (since 1992), due to the reforms on central bank characteristics, undertaken in the 90s in these countries. Central bank independence is low in countries such as Brazil, Lithuania, Bolivia and Colombia.

Regarding the correlation between central bank independence and macroeconomic variables, Alesina (1988) showed that in countries where the degree of central bank independence is high, the average inflation rates are lower. However, Grilli, Masciardano and Tabellini (1991) found a significant negative relationship between central bank legal

independence and average inflation. Cukierman (1992) obtained similar results for industrialized countries but not for developing countries, this asymmetry being attributed to the large gap between legal and actual independence in those countries.

Other authors have investigated the relationship between central bank independence and growth rate (Alesina 1993, Eijffinger 1998) and they found no dependency relationship.

On the other hand, Rogoff (1985) showed that higher central bank independence leads to lower inflation, the cost being greater variability of production. Likewise, Debelle and Fischer (1994) conclude that countries where central bank independence is high face higher costs during disinflation periods.

Moreover, Cukierman, Kalaitzidakis, Summers and Webb (1993) found that, in developed countries, there is a negative correlation between central bank independence and growth.

At the same time, Klomp and de Haan (2009) estimated the relationship between central bank independence index and an indicator of financial instability that the authors construct using factor analysis[3]. The results of their analysis indicate a negative, statistically significant, relationship between central bank independence and financial instability.

From this multitude of views in the literature, our goal, in this study, is to discover the relationship between the costs of systemic crises and central bank independence on the one hand, and between the inflation rate and central bank independence, on the other.

Given the above-mentioned issues, and considering the fact that central bank independence may influence the choice of certain policies or instruments for crisis management, this study analyses the relationship between it and the efficiency of systemic crisis management.

Having in view the results of Gregorio (1996), according to which central bank independence indices, developed by different authors, are strongly correlated, and their use in relation to other variables lead to similar results, in this study we use the central bank independence index developed by Cukierman, Webb and Neyapti (1992).

1. Research methodology and data

To test the relationship between the efficiency of crisis management and the degree of central bank independence, we used bi-variation regression models between central bank independence index developed by Cukierman (1992) calculated the Polillo and Guillén (2005), as independent variable, and the following dependent variables, which measure the cost and duration of crisis and which we believe can be used as indicators of crisis management efficiency:

- *duration*, represents the number of years in which GDP equals or exceeds the value it had before the onset of the crisis. The onset of the financial crisis is set according to the methodology described by Laeven and Valencia (2008a);

[3] the built indicator is a linear combination of several indexes regarding the banking system (changes in the assets on liabilities ratio, reserves / assets, equity / assets, non-government credit / GDP), banking crises, the return rates for different categories of assets and the monetary aggregates.

- *depth*, represents the maximum annual percentage decrease in GDP during the financial crisis. Positive values indicate the decrease of GDP and negative values indicate GDP growth;

- *average_inflation*, represents the average annual inflation rates during the financial crisis.

The calculated values for these variables are presented in Table no. 2:

Table no. 2: Duration and depth of systemic crisis and average inflation during their manifestation

Country	Duration (years)	Depth (%)	Average inflation (%)		Country	Duration (years)	Depth (%)	Average inflation (%)
Argentina 80	7	6,951	300,40		Jamaica	6	1,209	10,95
Argentina 89	2	7,007	2696,70		Japan	4	2,049	0,35
Argentina 95	2	2,845	1,76		Korea	2	6,854	5,97
Argentina 01	4	10,895	6,09		Latvia	2	2,084	21,3
Bolivia	0	-4,667	7,87		Lithuania	1	-1,23	39,46
Brazil 90	2	4,168	1712,56		Malaysia	2	7,359	2,77
Brazil 94	2	-4,22	1070,91		Mexico	2	6,167	20,98
Bulgaria	7	8,043	175,56		Nicaragua	0	-4,1	9,9
Chile	5	13,588	21,48		Norway	1	-3,105	3,42
Colombia 82	0	-0,948	24,5		Paraguay	0	-5,452	13,38
Colombia 98	4	4,204	11,68		Philippines	2	0,577	7,77
Cote d'Ivoire	4	-1,09	2,20		Russia	2	5,3	56,70
Croatia	2	1,503	4,86		Sri Lanka	0	-4,736	11,56
Czech Republic	3	0,759	9,36		Sweden	4	2,058	4,65
Dominican Republic 03	2	0,253	39,45		Thailand	6	10,51	2,97
Ecuador	3	6,299	61,46667		Turkey	2	5,697	54,64
Estonia	8	1,642	15,3015		Ukraine	4	1,949	18,355
Finland	6	6,244	2,062167		Uruguay	5	7,051	10,73
Ghana	5	6,909	43,9412		Venezuela	2	2,35	60,37
Indonesia	5	13,127	20,0478		Vietnam	0	-8,152	3,095

Source: Own calculations using World Economic Outlook database, www.imf.org/external/pubs/ft/weo [Accessed: 6 January 2010], Laeven and Valencia (2008a) to identify the onset of a crisis, Cecchetti (2009) for calculations regarding the duration of a crisis.

As we can observe in the above table, large crisis durations were registered in Argentina (1980), Estonia, Bulgaria, Finland and Jamaica. However, large annual decline in GDP (depth) were recorded in Chile, Argentina (2001) and Thailand, and the highest annual inflation rates during the crisis occurred in Brazil (both in the 1990 crisis and in 1994) and Argentina (1989).

We mention that the analysis is not affected by endogenous problem, specific to studies attempting to establish dependencies between policies adopted and the effectiveness of crisis management. Thus, unlike crisis management policies, which are often reactions of the authorities at various events and depend largely on their nature and seriousness central bank independence is a feature that only changes because of reform processes following the financial crisis and rarely during their unfolding (Polillo and Guillén, 2005).

The estimated bi-variation models have the following form:

$$Y_i = a * CBI_i + e_i \quad , \tag{1}$$

where:

Yi, is the dependent variable (is, in turn, duration, depth and average_inflation recorded for systemic crisis i);

CBIi, is the index of central bank independence in the country where systemic crisis i manifested;

e, represents the specification error (the effect of variables that were omitted from the model).

After we estimated the coefficients of bi-variation models, we introduced in the regression analysis a vector of control variables X. The multivariate models have the following form:

$$Y_i = a * CBI_i + bj * X_i + e_i \tag{2}$$

The vector X includes the following variables:

- *currency,* is a binary variable indicating the presence of a currency crisis in period [t-1, t+1], where t is the first year of systemic crisis. Currency crisis is defined using the methodology described by Leaven and Valencia (2008a). We expect that, in case a currency crisis occurs, the recovery process is slower and involves higher costs;

- *depgdp*, is the ratio of total deposits in the banking system to GDP, being a measure of the importance of the banking sector in the economy. We expect the duration and depth of the crisis to be higher in countries with large banking sectors (Laeven et Valencia, 2008a);

- *w_gppg*, is the real GDP growth rate worldwide in the year before the crisis. This variable was introduced because we expected the crisis management process to be more efficient in terms of duration and cost, when the degree of global economic development is high (due to potential foreign investments and other capital flows that can positively influence recovery).

Since the number of observations is small, we prefer not to introduce more variables in the regression models.

2. Results

The results of the regression models are summarized in Table no. 3, where we presented the estimated coefficients a[4] and b in equations (1) and (2), as well as their statistical significance (p-value)[5].

Table no. 3: Results of regression models

Endogenous variable / Exogenous Variables	**Model 1 (endogenous variable duration)**		**Model 1 (endogenous variable depth)**		**Model 1 (endogenous variable average_inflation)**	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
CBI	*5.9735*	*0.0000*	*7.7882*	*0.0000*	*-2.515*	*0.0000*
CBI	*6.9547*	*0.0001*	*6.7713*	*0.0344*	-21.2856	0.7113*
CURRENCY	*2.1365*	*0.0007*	*5.5154*	*0.0000*	38.8852	*0.0080*
W_GDPG	*-0.7855*	*0.0053*	-0.8734	0.1133*	1.1926	0.9020*
DEPGDP	*1.5580*	*0.0202*	0.0549	0.9681*	-11.6478	0.6604*

*Note: * p-value> 0.05 indicates a statistically insignificant coefficient for a confidence level of 95%*

The results of the bi-variation regression models indicate a positive[6], statistically significant[7], relationship between the duration and depth of systemic crises and central bank independence index and a negative, statistically significant, relationship, between the average inflation during the crisis and central bank independence index.

Thus, central banks with high independence indices have poor performance in crisis management process, embodied in greater decreases in real GDP and greater durations of systemic crisis.

Results of the dependency relationship between indices of central bank independence and duration/ depth of crisis remain statistically significant after the introduction of control variables in the model (multivariate models).

At the same time, the coefficients of control variables *currency, w_gdpg* and *depgdp* are statistically significant in the model with *duration* as the endogenous variable and have the expected signs. Thus, the duration of the crisis is larger when there was a currency crisis in period [t-1 t+1], where t is the first year of systemic crisis. This is indicated by the positive coefficient of *currency* variable in the multivariate regression model. The results also indicate that the crisis' duration is shorter when the degree of economic development is high, but is larger in economies with high large banking sectors than in those with less important banking sectors.

[4] regression slope.
[5] we mention that we performed stationary tests on variables and that they can be used in regression models. We also verified the linear regression model assumptions on homoschedasticity, correlation errors, multiple co-linearity, etc.
[6] since the regression coefficient is positive.
[7] p-value <0.01, indicating a nonzero value of the coefficient, with a 99% confidence.

In the multivariate model with *depth* as endogenous variable, only the coefficients for *CBI* and *currency* variables are statistically significant for a 95% confidence. These coefficients are positive, indicating deeper crises in countries where the central bank is more independent and where a currency crisis occurred.

If central banks with high independence indexes fail to reduce the duration and depth of crises, we can not say the same thing about inflation. The results of the bi-variation regression model indicate a negative, statistically significant, relationship between the average annual inflation rates during the crisis and the central bank independence index[8]. In the multivariate model, the coefficient of *CBI* variable loses statistical significance, indicating that there are inflation forecasting elements more important.

2.1 Sensitivity analysis

In order to analyze the sensitivity of results to alternative definitions of the efficiency of crisis management process, we estimated regression models (Table no.4) using the following endogenous variables (used in other studies as indicators of crisis management efficiency):

- *outpuloss*, represents the GDP decrease, compared to its potential level, calculated by extrapolation real GDP from previous years before the crisis (Leaven et Valencia, 2008a);

- *c_loss*, is the sum of the quarterly GDP gap from its maximum level before the crisis, calculated for the duration of the crisis and divided to the maximum level of GDP before the crisis (Cecchetti, et al., 2009). The maximum is calculated for a period of 4 quarters preceding the crisis. The difference between the two above-mentioned variables is that one is related to maximum level of GDP before the crisis and defines contraction by reference to it, and the other is related to potential GDP, in case the crisis would not have happened.

- *length*, is the number of quarters in which GDP is below the its maximum level before the crisis (Cecchetti, et al., 2009).

[8] extreme values of inflation rates (over 1000%) were eliminated from the analysis because they can distort results. At the same time, in the case of inflation rate, we used log data series, negative values of this variable being eliminated from the analysis because they can also distort the results, as a negative inflation rate is not a favorable economic situation.

Table no. 4: Regression models used to analyze the sensitivity of results

Endogenous variable / Exogenous Variables	Model 1 (endogenous variable: outputloss)		Model 2 (endogenous variable: c_loss)		Model 3 (endogenous variable: length)	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
CBI	*0.4288*	*0.0002*	*48.3282*	*0.0001*	*23.8940*	*0.0000*
CBI	0.4159	0.1149*	*73.7919*	*0.0068*	*27.8681*	*0.0001*
CURRENCY	*0.1847*	*0.0500*	14.9379	0.1384*	*8.6741*	*0.0007*
W_GDPG	-0.0583	0.2055*	*-8.7701*	*0.0109*	*-3.2460*	*0.0048*
DEPGDP	0.1142	0.2541*	9.6366	0.3951*	*6.2323*	*0.0286*

*Note: * p-value> 0.05 indicates a statistically insignificant coefficient for a confidence level of 95%*

Models estimated using alternative measures of the efficiency of crisis management (in terms of cost and duration) lead us to the same results: the regression coefficients are positive and statistically significant in all bi-variation models. In the models in which we introduced control variables, the coefficient of *CBI* variable loses statistical significance only when the endogenous variable is *outputloss*.

2.2 Comparing the results with those of other studies

To check whether results are consistent with those obtained by other researchers, we will refer to those obtained by Detragiache and Giang Ho (2010), who built an index of costly policies used for systemic crisis management. High values of this index shows the use of crisis management policies involving major financial resources. The authors showed that more risky policies (which uses more financial resources) lead to slower economic recovery.

Testing the relation between policy index and central bank independence index, we found a positive, statistically significant relation indicating that many independent central banks use more expensive crisis management policies thus leading to higher costs of the crisis. (Table no. 5)

Table no. 5: Results of the regression model with the index constructed by Detragiache and Giang Ho as endogenous variable and central bank independence index as exogenous variable

	endogenous variable: policy index (Detragiache and Giang Ho)	
	Coefficient	**p-value**
exogenous variable CBI	2.4845	0.0002

Conclusions

Choosing the appropriate policy and institutional framework for systemic crisis management is a major concern in the current economic context, researching the characteristics that may influence the effectiveness of systemic crisis management, thus, gaining special importance. Therefore, this study underlines, on the one hand, that a high degree of central bank independence does not lead to faster economic recovery or to lower economic costs. On the other hand, high central bank independence provides, however, lower average annual inflation rates during the crisis, because more independent central banks pursue their central objective, namely to maintain price stability, leaving a sideline other macroeconomic policy objectives.

Given the above, we consider that, in choosing the appropriate institutional framework for effective systemic crisis management, namely granting a certain degree of independence to central banks, it should be taken into account, on the one hand, the central bank's role and importance in maintaining price stability and financial stability and, on the other hand, the costs, duration and depth of systemic crises, in case they occur.

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